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ENERGY SCIENCES NETWORK

Transatlantic Networking

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U.S. DEPARTMENT OF ENERGY
Office of Science

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ESnet Transatlantic Networking - Historical Perspective

- 2014: ESnet established transatlantic and European network segments
  - 340Gbps across the Atlantic (3x100G, 1x40G) on diverse cables
  - 100Gbps ring in Europe, on GEANT waves (Amsterdam, London, 2 CERN locations)
  - European presence fully integrated into ESnet backbone network
- Late 2017: Upgrade to 400Gbps
  - 40G circuit from Boston to Amsterdam upgraded to 100Gbps
  - Still diverse cables for resiliency
- Plans in place for additional capacity
  - Waiting until demand justifies expenditure
  - See next few slides

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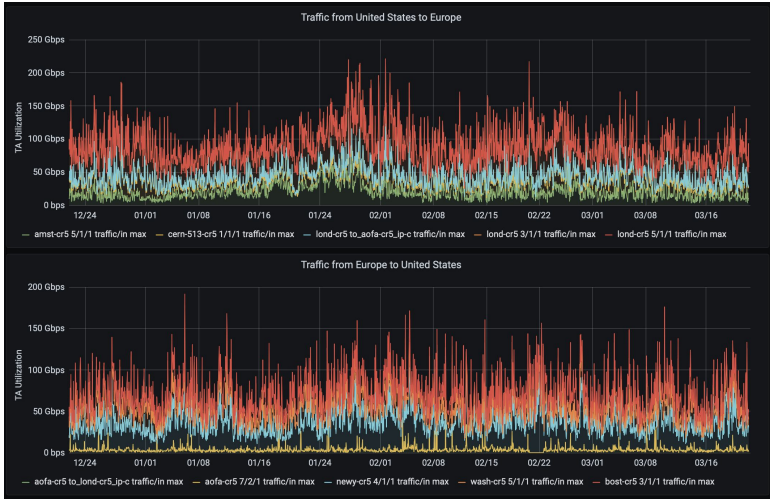
Capacity planning based on historical data

- Capacity planning process for ESnet backbone, including European ring and transatlantic circuits
- Based on network statistics from router interfaces
  - Interface counters
  - Netflow data
- Many thanks to Richard Cziva for ongoing efforts



Aggregate peak utilization on TA links by direction (Jan 2021 - March 2021)

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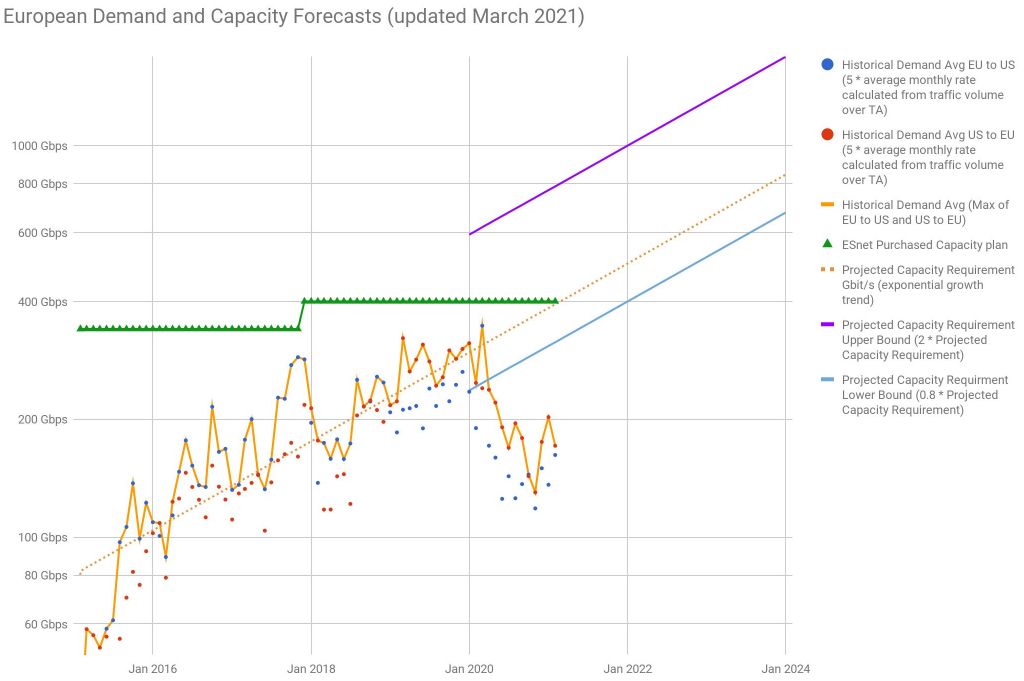
Capacity trends: pandemic influence

- Significant drop in utilization due to pandemic and LHC shutdown
- When is the right time to add more capacity?



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Run3 needs

- Multiple inputs to Run3 forecasting
  - 2020 ESnet/HEP Formal Requirements Review
  - Discussions with USATLAS and USCMS leadership
  - Historical data
- Consensus: no need to provision more transatlantic bandwidth now
  - Current capacity is good for production needs at the *start* of Run3
  - Current mechanisms and processes are sufficient to see increased demand with sufficient warning to add capacity on actionable time scales
- Production bandwidth growth during Run3
  - Carefully track bandwidth use during CY22
  - Regular conversations with USATLAS and USCMS operational leadership

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Planning for HL-LHC

- Predictions based on the RAW data produced by ATLAS and CMS detectors is ~1.4 Tbps across Atlantic
  - Includes over provisioning due to bursts and redundancy
  - Redundancy is key - undersea cable outages can last for weeks
- Capacity projections looking at historical data track closely at ~1.5Tbps
- Open Questions: Research bandwidth - timing and capacity
  - Capacity for data challenges, development of capabilities for HL-LHC
  - Begin discussions on this at April blueprinting meeting

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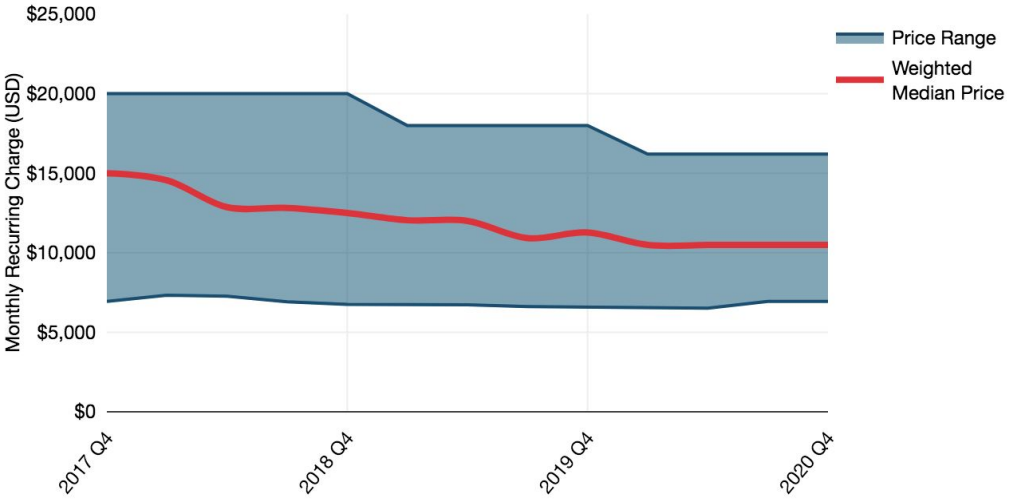
Does this capacity seem feasible?

- Traffic prices across the Atlantic declining significantly



100Gbps monthly lease price (London/NY)

NY-LON is the cheapest route
Other routes more expensive

Credit: Telegeography
PTC 2021 Workshop

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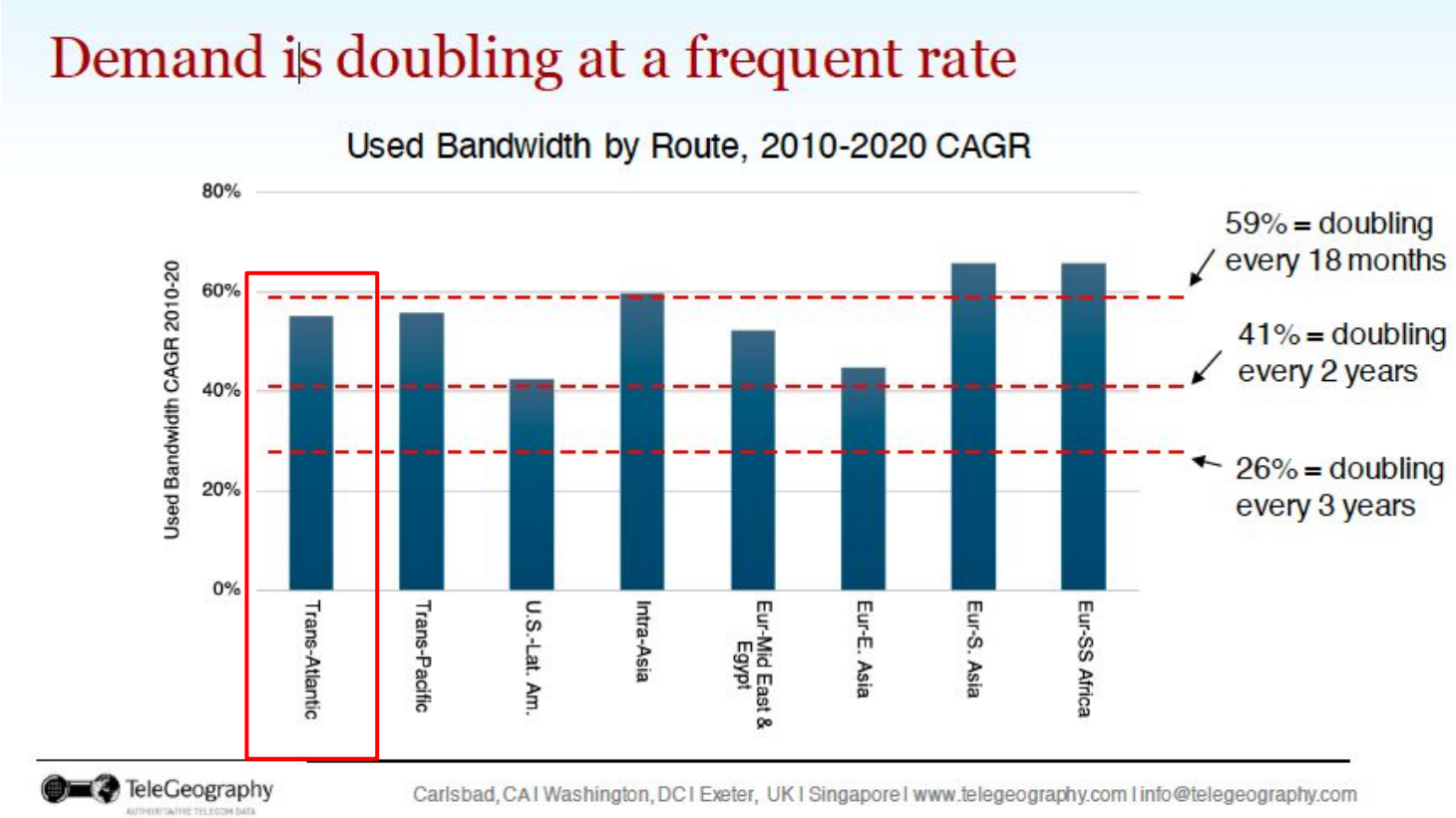
Will this price erosion continue over the next 6 years?



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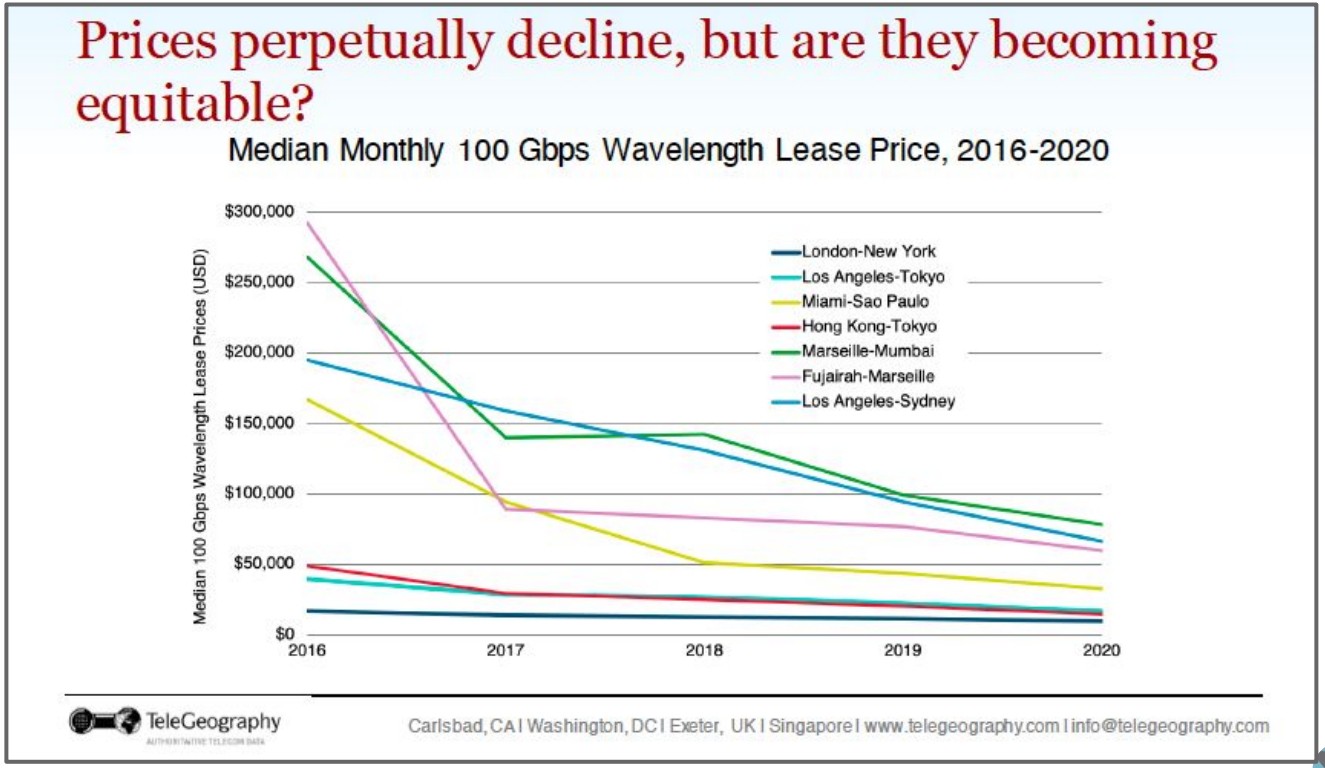

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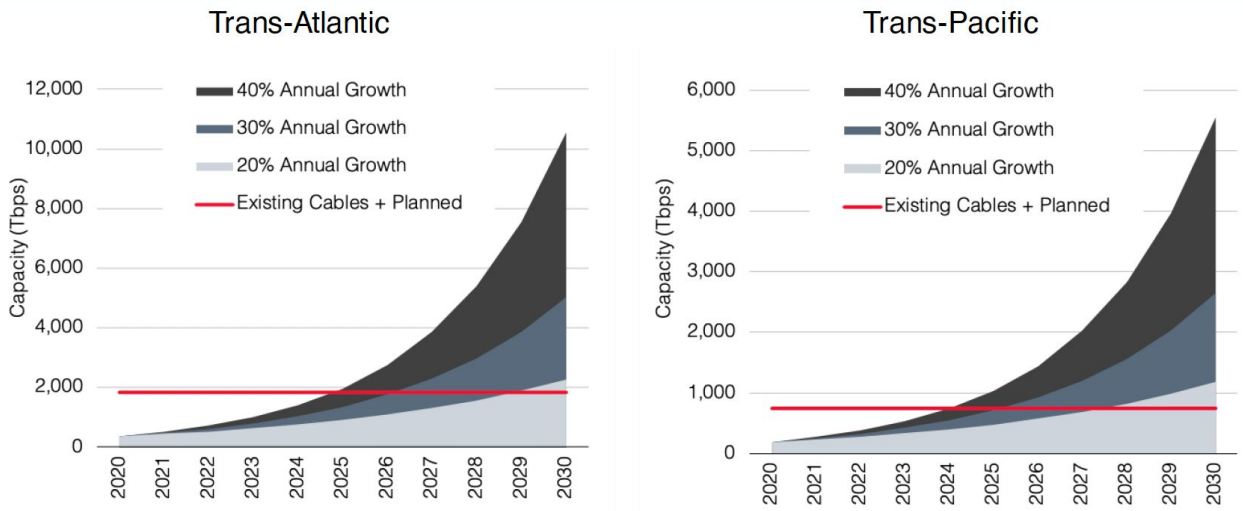
The experts predict need for more cables to meet the growing demand

We'll need a lot more cables (and tech advances)



TeleGeography
AUTHORITATIVE TELECOM DATA

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ESnet approach to meet the TA requirements of US-LHC

- Nurturing relationships with all telecommunications carriers selling TA bandwidth
- As current contracts expire, looking at longer term [10+yr] bandwidth leases
- Close collaboration with OTTs, ANA consortium to explore potential opportunities in spectrum
- Increasing the bandwidth in Europe to match the TA capacity required
- Resiliency demands that we have at a minimum three paths with desired throughput

Full support from DOE for continuing to meet the production networking needs of the LHC experiments

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Summary

- LHC Run 2 has taken great advantage of sufficient bandwidth across Transatlantic; traffic across the Atlantic has seen significant growth
- LHC Run 3 will continue to take advantage of this capability, without needing significant additional capacity initially
- HL-LHC requires a dramatic increase in capacity across the ocean
- ESnet is investing in partnerships, market understanding, as well as putting plans in place to support the bandwidth needs of the LHC community

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Thanks!

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